Project Summary (BIOE)

Adhesive bandages are intended to cover and protect wounds from further harm. They hold cuts together, control fluid secretions and provide a barrier against environmental factors. According to the Center for Disease Control and Prevention (CDC), nearly 270,000 Americans died from the life-threatening disease of sepsis in the year of 2020. Covering wounds with bandages, however, significantly diminishes the chances of uncontrolled microbial proliferation, which can therefore lower the likelihood of these complications. Current bandage creations exist in a myriad of shapes, sizes and colors that adhere to unique customer needs. Moreover, some include advanced qualities that incorporate water resistance and healing ointments. Despite the many benefits current bandages on the market provide, opportunities for improvement are still abundant.

Although there are many different types of bandages on the market, there is a lack of bandages that allow for users to detect an infection. To address this issue, we designed a plastic free bandage with infection detection technology. This 3" x 1" bandage features a backing made from 55% hemp and 45% cotton along with a 0.8" x 0.8" cotton pad embedded with 0.04% Bromothymol blue and a semipermeable membrane.

On the adhesive side of the bandage, there is an absorbent pad that measures 0.8" x 0.8". The pad is layered, and it contains the infection detection technology. The cotton layer is in contact with the wound, and it serves as the layer for blood and fluid absorbance. The next layer is a thin, semi-permeable membrane. A semipermeable membrane filter allows for smaller molecules, such as hydrogen (H^+) ions, to pass through while simultaneously preventing larger molecules and proteins, such as blood, from advancing. It was important to incorporate the semi-permeable membrane because it prevented the possibility of blood from disrupting the color change of the pH. Although the color is not as bright, it's most likely due to the fact that other fluids in the wound might be able to travel through the semipermeable membrane and dilute the pH indicator solution a tad bit. However, the color change is still significant enough for the users to be able to tell whether their wound is infected or not.

The layer above the semipermeable membrane is another cotton pad, which holds 100 µL of 0.04% Bromothymol blue. Bromothymol blue is a pH indicator that changes color over a pH range from 6.0 - 8.0. At a pH of about 6.0, the indicator is a visible bright green color. At the pH of blood, which is about 7.4, the indicator will turn into a turquoise color. At a pH of 8.0 or more, which is the pH of an infected wound, the indicator is vibrantly blue in color. The layer containing the Bromothymol blue is in contact with the adhesive side of the bandage. There will be a small circle cutout with a transparent cellulose film on the bandage, which will allow for clear visibility of any color change that may occur.

An essential component of bandages is mobility and flexibility when they are placed on the body. Therefore,we performed a stress-strain analysis on different types of fabric before settling on a cotton-hemp mixture. This was due to the fact that hemp fabric is not as flexible as cotton or bamboo, but it's much more durable. A mixture between hemp and cotton was ultimately decided upon for our product to maximize the durability needed without compromising its stretchiness. A hemp-cotton fabric is comparatively more biodegradable than plastic or synthetic fabric, sufficient at wicking away water, comfortable, and can be easily manipulated in terms of color. Our bandage is different from any other product on the market due to its infection detection technology and its biodegradable properties. We believe our bandage design will be well received by consumers, competitive with respect to other adhesive bandages, and extremely profitable.